Methodology

The following tables in this section assess the potential risk to receptors from the following hazards, taking into account the measures proposed to reduce those risks.

The method relies on a scoring system that is based on the frequency or probability of the event occurring and the resulting consequence or potential effect of the event on the environment.

Controls or mitigation are also identified in the assessment, which consist of measures or actions that can be carried out to limit the potential for impacts.

The probability of exposure is the likelihood of the receptors being exposed to the hazard, and is defined as low, medium or high. These terms are qualified as follows:

- Low: exposure is unlikely, barriers in place to mitigate against exposure;
- Medium: exposure is fairly probable, barriers to exposure less controllable; and
- High: exposure is probable, direct exposure likely with few barriers.

The aim is it to reduce the risk of fugitive emissions from the facility or the impact of the emissions on the environment, through specific mitigation measures identified for each specific risk.

Control and mitigation measures have been identified for all risks identified in the assessment, based on the Best Available Techniques (BAT) measures set out in the guidelines and on operational experience. The measures specific to each risk are described in the assessment. The mitigation measures will be incorporated into the Site management processes and Site operatives will be made aware of these measures during training.

More general mitigation measures to avoid emissions, in line with indicative BAT standards, are also set out in the relevant sections of the Main Supporting Document.

Figure 3: Risk Assessment Matrix

Consequence	Exposure probability		
	Low	Medium	High
Low	Low Risk	Low Risk	Medium Risk
Medium	Low Risk	Medium Risk	High Risk
High	Medium Risk	High Risk	High Risk

Table 3.1: Severity Index

Severity of harm	Severity Index
Impact to people or designated receptor	High
Impact to non-designated receptor	Medium
All other impacts	Low

Table 3.2: Probability Index

Likelihood of harm occurring	Probability Index
Harm is near certain or very likely to occur	High
Harm is likely to occur	Medium
Harm is unlikely	Low

Table 3.3: Magnitude of risk

Magnitude of risk	Probability index		
Severity index	**Low**	**Medium**	**High**
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Medium	High	High

Figure 3: Climate Change Risk Assessment Matrix

Risk Assessment	Definition	Score Range
Frequency (or probability)	Describes the likelihood of the event occurring.	1 (least frequent) – 6 (most frequent)
Consequence	Describes the potential effect of the event on the environment.	1 (least consequent) – 6 (most consequent)
Risk	Risk is frequency multiplied by consequence.	1 – 36 (36 greatest risk)

Emissions to air

Hazard	Receptor	Pathway	Risk reduction measures	Exposure probability	Potential consequences	Exposure rating	Consequence rating	Overall risk
Emissions from gas engines	Local residents and businesses beyond the boundary of the Teesside Terminal. See human and ecological receptors listed in Main Supporting Document Table 7-1 and Table 7-2.	Air	Dispersion modelling of indicative emissions from the E2P Power Island have been carried out and indicate that there is unlikely to be any exceedance of AQS or EALs at identified human health receptors. For ecological receptors, the long term predicted environmental concentration (process contribution + background concentration) for the annual average and 24-hour NOx are up to 130% and 97% of the respective Critical Levels. This suggests there will be a potential significant impact on ecological receptors in the designated sites in close proximity to the E2P Power Island. However, critical levels are defined for the protection of vegetation, and the area under concern is mud flats that undergo regular tidal inundation, with no vegetation present. It is therefore considered that the critical levels are not directly applicable to this location. In addition, the area over which the peak impacts occur represents a very small proportion of the habitat site as a whole, as predicted concentrations reduce rapidly with distance from the E2P power island. It is therefore considered that the impacts from NOx on the Teesmouth and Cleveland Coast designated site as a result of the operation of the E2P Power Island, are unlikely to result in any significant impact. It is expected that overtime with the decline in throughput at the Installation the production of fuel gas for use in the gas engines will decrease over time. The number of gas engines will reduce in line with the reduction in fuel gas and emissions to air will reduce (see section 4.2.2 of Main Application Document).	High exposure probability due to continuous operation of gas engines	Low potential consequence due to close proximity of a designated ecological receptor (Teesmouth and Cleveland Coast located adjacent to the north of the site). However, there is not likely to be a significant impact due to the lack of vegetation at the ecological receptor and because the impacts are predicted in a small portion of the designated habitat. The potential consequence will reduce over time as the amount of ethane and number of operational gas engines reduces.	High	Low	Medium

Flaring of fuel gas	Local residents and businesses beyond the boundary of the Teesside Terminal. See human and ecological receptors listed in Main Supporting Document Table 7-1 and Table 7-2.	Air	There are two existing flares at the Installation designated to provide warm and cold pressure relief. The built in redundancy and flexibility of the E2P Power Island has been designed to minimise the use of a flare, as detailed in the Site-specific BAT Assessment (Appendix D). However, in the event that pressure relief is required, the fuel gas will be transferred to the existing flares. The alternative to flaring gas during an overpressure event is to vent. As stated in the Refineries BReF, flaring gas is preferred as it can significantly reduce the emissions of pollutants when compared to venting, which releases excess gas directly to the atmosphere.	High due to continuous operation of flare pilot flame. However, the frequency of flaring fuel gas from E2P Power Island will be low, as the plant will be designed to avoid this event occurring.	Low potential consequence on human health and ecological receptors in surrounding area. Given the flare is already operational for the existing activities at the Teesside Terminal, the E2P Power Island will not lead to additional impact on surrounding receptors.	High	Low	Medium

Fugitive emissions

Hazard	Receptor	Pathway	Risk reduction measures	Exposure probabilit	Potential consequen	Exposure rating	Consequence rating	Overall risk
Release of fuel gas through leakage from fuel tanks and pipes	On-site staff, local residents and businesses beyond the boundary of the Teesside Terminal. See human and ecological receptors listed in Main Supporting Document Table 7-1 and Table 7-2.	Vapours and odours carried by the wind	The following measures will be in place to mitigate, detect and react to a gas leak in the pipework: - Pressure sensing instrumentation will be installed in the gas supply system connected to alarms which would alert operators to a loss of pressure and also trip systems which would initate appropriate emergency actions such as automatic isolation of the gas supply if the pressure reached a pre-defined limit. - An Emergency Shutdown System (ESD) will be operated in the event of a significant incident such as an accidental loss of containment of fuel gas. This will isolate sections of pipework to limit the volume of gas which could potentially be released. - A network of gas detectors will be installed on the E2P Power Island to alert operators to a leak. - release of gas, which will initiate the appropriate safety systems including ESD. - The piping design pressure will be based on the maximum pressure that any associated piece of equipment can generate or the stalling pressure of a reciprocating compressor. An additional 10% safety margin will be added to all pipework.	Low exposure probability due to implementation of risk reduction measures to prevent a gas leak	Medium potenital consequence on human health and ecological receptors in surrounding area.	Low	Medium	Low

			- The majority of the pipework on site will be designed to the ASME B31.3 standard. - Regular inspection of the E2P Power Island’s infrastructure will be undertaken by the contractor. Routine operational checks and infrastructure audits are likely to comprise identification of issues relating to equipment degradation; standing water in bunded/ kerbed areas; and storage areas.					

Spillage of lubrication oil to surface water or groundwater during refilling of lubrication oil tanks	Local surface water and groundwater	Flow path is determined by surface topography and drainage systems	The design intent of the E2P Power Island is that all activities and equipment containing liquid hydrocarbons such as lubrication oil will be carried out on an impermeable surface with a closed drainage system which will be curbed and routed to the Installation's drainage system where it will be treated in the Effluent Treatment Plant which is fitted with hydrocarbon removal processes. The collected hydrocarbon will then be placed through the Teesside Terminal's processes. There will be no direct discharges to unmade ground or surface water/groundwater. Raw material substances will be stored in an appropriatly bunded container which will be regularly inspected. Spill kits designed to deal with the stored material will be in the proximity of storage areas and fill points in the event of a spill. The EMS will comprise procedures for controlling raw material delivery including for oil transfer operations, and spill response procedures. All relevant personnel will be trained on how to handle a spill incident.	Low due to curbing of made ground at the Installation so that all spills are routed to the CoP Terminal drainage system where they will be treated.	High adverse impact on human health and ecological receptors in surrounding area due to close proximity of designated ecological receptor.	Low	High	Medium

Spillage of waste lubrication oil to surface water or groundwater	Local surface water and groundwater	Flow path is determined by surface topography and drainage systems	The design intent of the E2P Power Island is that all activities and equipment containing liquid hydrocarbons such as lubrication oil will be carried out in areas n an impermeable surface with a closed drainage system which will be curbed and routed to the CoP Terminal drainage system where it will be treated in the Effluent Treatment Plant which is fitted with hydrocarbon removal processes. The collected hydrocarbon will then be placed through the Terminal stabilising processes. There will be no direct discharges to ground.	Low due to curbing of made ground at the Installation so that all waste oils are routed to the Installation's drainage system where they will be treated.	High adverse impact on human health and ecological receptors in surrounding area due to close proximity of designated ecological receptor.	Low	High	Medium

Nuisances

Hazard	Receptor	Pathway	Risk reduction measures	Exposure probab	Potential consequenc	Exposure rating	Consequence rating	Overall risk
Mud/ litter carried onto highway	Land and water	Public	All internal roads, storage and processing areas will be hard-surfaced with concrete or tarmac and swept when required The E2P Power Island will be within the Installation where there are existing procedures to manage waste and litter on site.	Low due to established site procedures at existing site for the management of waste and litter	Low adverse impacts on local receptors	Low	Low	Low
Pest, vermin and scavengers	Land and water	Staff and public	The E2P Power Island will be within the Installation where there are existing procedures to manage waste and litter on site. The current procedures used to manage pert, vermin and scavengers across the Teesside Terminal will be applied at the E2P Power Island.	Low due to established site procedures at existing site for the management of pests, vermin and scavengers.	Low adverse impacts on local receptors	Low	Low	Low
Waste generation	Land and water	Staff and public	Waste lubricating oil will be generated from the use of the engines. Waste lubrication oil will be collected and transported off site by a third-party contractor to be disposed of at an appropriate and licensed facility. All wastes will be stored in appropriate, labelled containers and stored in designated bunded waste storage areas. All bulk waste storage tanks will be within bunds with 110% capacity of the primary container. All other wastes generated such as packaging and general wastes will be managed through existing waste management practices at the installation, implemented through the Installation's EMS and in accordance with BAT.	Low waste oil will be stored temin a suitably bunded container before being transported off site by a third-party contractor to be disposed of off-site.	Low adverse impacts on local receptors	Low	Low	Low

Noise

Hazard	Receptor	Pathway	Risk reduction measures	Exposure probab	Potential consequenc	Exposure rating	Consequence rating	Overall risk
Noise and vibration from the operation of the E2P Power Island	On-site staff, local residents and businesses beyond the boundary of the Teesside Terminal. See human and ecological receptors listed in Main Supporting Document Table 7-1 and Table 7-2.	Air/ wind	The sound pressure level from the enclosure is limited to a maximum noise level of 80dB(A) measured at 1 metre from the equipment or engine enclosures / buildings. The results of the Noise Impact Assessment determined the impact from the plant is low on the closest noise sensitive receptor.	medium as the plant will be in operation frequently.	low adverse noise impacts on local receptors	medium	low	Low

Odour

Hazard	Receptor	Pathway	Risk reduction measures	Exposure probab	Potential consequenc	Exposure rating	Consequence rating	Overall risk
Odour	On-site staff, local residents and businesses beyond the boundary of the Teesside Terminal. See human and ecological receptors listed in Main Supporting Document Table 7-1 and Table 7-2.	Air/ wind	Process fuel gas is not odourised. No other permanent sources of odourous substances will be present ion the E2P Power Island. A small quantity of natural gas from the local distribution network will be used for commissioning and black start only which will be odourised however this will be used for a short duration only and used within the gas engines with no direct release to air.	Low due to since ethane and methane are odourless gases, and the fuel gas will not be odourised. Historically, there have been no odour complaints at the existing site which already uses the fuel gas mixture.	Low adverse odour impact on local receptors. There are established odour management plans for the existing site which will apply to the E2P Power Island	Low	Low	Low

Accidental release

Hazard	Receptor	Pathway	Risk reduction measures	Exposure probab	Potential consequenc	Exposure rating	Consequence rating	Overall risk
Fire	On-site staff, local residents and businesses beyond the boundary of the Teesside Terminal. See human and ecological receptors listed in Main Supporting Document Table 7-1 and Table 7-2.	Emission of smoke to the air, transported by the wind. Emission of firewater and foam to drainage systems, water and land.	The following measures will be in place to reduce the risk of fire: - The layout will be designed such that location of areas and equipment does not introduce unacceptable risk related to fire and explosion. - The E2P Power Island will be systematically evaluated and classified by hazardous emission/ discharge sources for flammable gases and fluids. - Selection of electrical apparatus located in outside areas will follow authority regulations, standards, and Company requirements for operation in explosive atmosphere where applicable. All electrical and instrument equipment located outside in natural ventilated areas shall be certified safe type apparatus for the applicable level of hazardous areas. - The E2P Power Island will be equipped with a fire and gas detection system, which ensures rapid and reliable detection of outbreak of fires and gas leakages. The system shall be able to perform the intended functions independently of other systems. Location of detectors will be based on relevant scenarios, simulations, and tests. - The E2P Power Island will also be equipped with fire hydrants. All firewater will be routed via made ground to the Effluent Treatment Plant. - Isolation of ignition sources and power supply to electrical equipment in areas will be performed in order to limit the probability for ignition of a gas leak. - All valves used for emergency isolations will be of Fire Safe design, Anti-Static and will conform to BS EN ISO 10497:2004, API 607 4th Edition or the equivalent.	Low due to fire risk reduction measures	High adverse impact on local ecological recpeptors	Low	High	Medium

Flooding	On-site staff, local residents and businesses beyond the boundary of the Teesside Terminal. See human and ecological receptors listed in Main Supporting Document Table 7-1 and Table 7-2.	Flow path is determined by topography and drainage systems	The Environment Agency Flood Maps For Planning show that the site is located within a Flood Zone 1, defined as land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%) – very low. The proposed drainage system at E2P Power Island will be designed to prevent any flooding for a 1 in 30 year return period design storm, including a 20% allowance for climate change.	Low as demonstrated by EA Flood Maps for Planning	High adverse impact on local ecological receptors	Low	High	Medium

Security and vanadalism	On-site staff, local residents and businesses beyond the boundary of the Teesside Terminal. See human and ecological receptors listed in Main Supporting Document Table 7-1 and Table 7-2.	Pathway of emissions coud be land, air or water. Emissions could potentially occur due to failure/ reduced performance of equipment and infrastructur e	The E2P Power Island is situated within the boundary of the wider Terminal. The Terminal benefits from existing security including perimeter fencing, security controlled access and CCTV.	Low due to extensive security measures onsite	Low	Low	Low	Low

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Global warming potential

Hazard	Receptor	Pathway	Risk reduction measures	Exposure probability	Potential consequences	Overall risk
Generation of greenhouse gas emissions	National and global climate	Air	The E2P Power Island will consist of up to 16 gas engine units that use an ethane/methane gas mixture as fuel. The gas engines will emit greenhouse gases to the atmosphere. There will be an increase in CO2 emissions as a result of using fuel gas to replace imported electricity. However is should be noted that if the fuel gas was not utilised in the E2P Power Island then this would be flared and essentially wasted. The flaring of the gas would result in 877,740 tonnes over the lifetime of th E2P project. Therefore it is considered that the E2P Power Island actually results in a significant reduction (-333,500) in CO2 emissions overall (see section 7.4.5 of the Main Supporting Document). The following measures will be taken to increase the energy efficiency of the process and maximise the energy generation of the facility: - The use of high efficiency gas engines (>40%) - Each engine shall be made 'ready' to transfer thermal energy for future energy recovery purposes. - The Contractor shall make sufficient provision to ensure associated equipment can be simply installed in the future. However it should be noted that the Combine Heat and Power Assessment Cost Benefit Analysis Assessment (Appendix G of Main Supporting Document) concluded that heat extraction from the E2P Power Island does not offer an economically viable solution. - Flanged connections shall be installed on the jacket water flow and return connections to facilitate such a connection and are to be fitted with blank flanges.	Low	Low adverse impact on the environment	Low

Climate change risk assessment

Potential change	Impact	Likelihood	Severity	Risk	Mitigation	Likelihood (after mitigation)	Severity (after mitigation)	Residual Risk
1) Summer daily maximum temperature may be around 7°C warmer than average summer temeratures now	An increase in cooling water temperature may cause a drop in efficiency, higher temperature discharge or decreased operation	1	1	1	Water consumption is expected to be limited to the use within jacket cooling system. The engine vendor is yet to be selected therefore the capacity and type of cooling system is yet to be confirmed.	1	1	1
2) Winter daily maximum temperature could be 4°C more than the current average, with the potential for more extreme temperatures, both warmer and colder than present.	Increases in temperature may cause a drop in efficiency, but a lower risk than in summer.	1	1	1	Unlikely to result in an impact to the proposed activity and its operation. No proposed mitigation.	1	1	1
3) Daily rainfall intensity could increase by up to 20% on today's values resulting in flooding on the Site.	- Flash flooding on Site - Surface water run-off systems need to be cleared and account for increased flows to prevent them being overwhelmed - Potential for increased Site Surface water flooding	1	3	3	The Site is located within a Flood Zone 1 and therefore has a lower risk of flooding. All surface water will be directed to the existing Installations Effluent Treatment Plant, which has sufficient capacity to handle increased volumes of surface water.	1	3	3
4) Average winter rainfall may increase by over 40% on today's averages resulting in potential increased risk of Site surface flooding and could impact Site wide drainage capacity	- Flash flooding on Site - Surface water run-off systems need to be cleared and account for increased flows to prevent them being overwhelmed - Potential for increased Site Surface water flooding	1	3	3	The Site is located within a Flood Zone 1 and therefore has a lower risk of flooding. All surface water will be directed to the existing Installations Effluent Treatment Plant, which has sufficient capacity to handle increased volumes of surface water.	1	3	3

5) Sea level rise which could be as much as 0.6m higher compared to today's level.	Fluvial flooding on the Site. Site surface water systems and effluent treatment plant may become overwhelmed and unable to discharge for prolonged periods due to backing up.	1	3	3	The Site is located within a Flood Zone 1 and therefore has a lower risk of flooding. All surface water will be directed to the existing Installations Effluent Treatment Plant, which has sufficient capacity to handle increased volumes of surface water.	1	3	3
6) Drier summers which could see potentially up to 40% less rain than now.	Reduction in availability of water consumption on Site.	1	2	2	The only water consumption required for the site will be in the closed loop water cooling jackets for the gas engines. The water consumption will be minimal and therefore unlikely to be impacted significantly by water availability. No proposed mitigation.	1	2	2
7) Flows in river could be 50% more than now at its peak and 80% less than now at its lowest	Reduction in availability of water consumption on Site.	1	2	2	The only water consumption required for the site will be in the closed loop water cooling jackets for the gas engines. The water consumption will be minimal and therefore unlikely to be impacted significantly by water availability. No proposed mitigation.	1	2	2
	Surface flooding	1	3	3	The Site is located within a Flood Zone 1 and therefore has a lower risk of flooding. All surface water will be directed to the existing Installations Effluent Treatment Plant, which has sufficient capacity to handle increased volumes of surface water.	1	3	3

8) Storms	Storms could see a change in frequency and intensity. The unique combination of increased wind speeds, increased rainfall, and lightning during these events provides the potential for more extreme storm impacts. Storms and high winds could damage building structures with increased potential for fugitive emissions.	1	2	2	E2P Power Island will not comprise any relatively tall structures and are therefore unlikely to be impacted significantly by high winds.	1	2	2